No. 14-1508

UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

EMCORE CORPORATION,
Appellant

v.

NICHIA CORPORATION
Appellee

and

MICHELLE K. LEE, Deputy Under Secretary of Commerce for Intellectual Property and Deputy Director, U.S. Patent and Trademark Office,
Intervenor

Appeal from the United States Patent and Trademark Office, Patent Trial and Appeal Board in IPR2012-00005.

BRIEF OF APPELLEE NICHIA CORPORATION

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CERTIFICATE OF INTEREST

Counsel for Appellee Nichia Corporation certifies the following:

1. The full names of every party or amicus represented by me is:

   Nichia Corporation.

2. The name of the real party in interest (if the party named in the caption is not the real party in interest) represented by me is:

   None.

3. All parent corporations and any publicly held companies that own 10 percent or more of the stock of the party or amicus curiae represented by me are:

   None.

4. The names of all law firms and the partners or associates that appeared for the party or amicus now represented by me in the trial court or agency or are expected to appear in this court are:

   Turner Boyd LLP: Matthew A. Smith.

   Foley & Lardner LLP: Stephen B. Maebius, Michael D. Kaminski, Andrew S. Baluch.

November 10, 2014

/s/ Matthew A. Smith
Matthew A. Smith

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STATEMENT OF RELATED CASES

Counsel for Appellee Nichia Corporation certifies that there has been no other appeal in or from this proceeding that was previously before this or any other appellate court.

STATEMENT OF THE ISSUES

A counterstatement of the issues, free from advocacy, may be useful to the Court.

1. Did Emcore waive its procedural objection to the Luther publication?

2. In an inter partes review, does 35 U.S.C. § 312 prohibit the submission of additional evidence after the petition filing, other than by motion under 37 C.F.R. § 41.123?

3. Did the Patent Trial and Appeal Board ("Board") properly construe the term "annealing," and if not, would Emcore's proposed construction have altered the outcome?

4. Did the Board properly construe the term "base layer," and if not, would Emcore's proposed construction have altered the outcome?

5. Were the Board's factual findings about the teachings of the references supported by substantial evidence?

6. Did the Board sufficiently articulate its reasons for finding that it would have been obvious to anneal Kidoguchi's contact?

STATEMENT OF THE CASE

In this inter partes review of U.S. Patent No. 6,653,215 ("the '215 patent"), the Board found claims 1-17 obvious over the references presented in Ground 4 of Nichia's petition. The Board's decision is published at *Nichia Corp. v. Emcore Corp.*, 2014 Pat. App. LEXIS 746 (P.T.A.B. Feb. 11, 2014).

STATEMENT OF THE FACTS

The '215 patent's lone independent claim is directed to a method. The method begins with an n-type III-V semiconductor. On that semiconductor are deposited four metal layers (Aluminum, Titanium, Platinum and Gold) in sequence, forming a stack. Finally, the structure is "annealed" (simplistically: "heated"). The result is a semiconductor contact. Claim 1 is reproduced below, together with a diagram showing the resulting contact:

> A method of forming a contact on an n-type III-V semiconductor comprising the steps of:
>
> (a) depositing **Al** on the n-type III-V semiconductor to provide a base layer; then
>
> (b) depositing **Ti** on said base layer to provide a first barrier layer; then

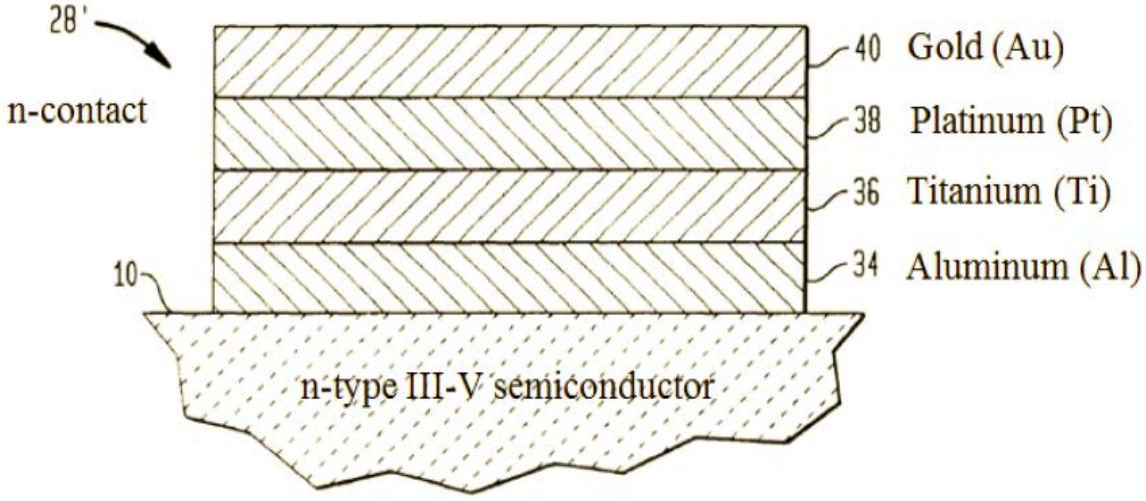
(c) depositing **Pt** on said first barrier layer to provide a second barrier layer; then

(d) depositing **Au** on said second barrier layer to provide a top layer, whereby said base layer, said first barrier layer, said second barrier layer, and said top layer form a stack on the n-type semiconductor; and then

(e) **annealing** said n-type III-V semiconductor with said stack thereon.

(A00005-06 (emphasis added).) The structure that results from this method is shown below:

FIG. 3



(A00005.) The layers in this resulting stack are sometimes written as Al / Ti / Pt / Au. (A00142.)

The named inventors considered their contribution to the art to be

the middle two layers (abbreviated "Ti / Pt") of this four-layer stack. Emcore states that:

> "One **key to the patent's breakthrough** is the use of multiple barrier layers composed of titanium and platinum. The **barrier layers act to 'prevent undesirable reactions between Al and** the metal of the top layer **Au** during annealing.'"

(Emcore Br. 13 (emphasis added).) Thus, Emcore argues that Aluminum (Al) and Gold (Au) layers interact poorly upon annealing. (A00171-72.) The interaction is detrimental to the surface of the Gold layer. (A00172.) The Gold layer is on top, and thus the only exposed layer. (A00149-50, ¶35.) Because of this, the Gold layer is used to connect to outside wiring. (*Id.*) If the Gold layer is damaged, wiring becomes more difficult. (A00172.) In order to avoid this problem, the named inventors sought some way to separate Gold and Aluminum. (A00171-72). They did this by using a diffusion barrier having Titanium and Platinum layers (abbreviated "Ti / Pt"), believing this to be novel. (A00171.)

The inventors were, however, very late to this insight. In fact, the use of Ti / Pt as a diffusion barrier between Al and Au had been worked

out during the 1970s. (A20207.) Since that time, the method has been used in semiconductor contacts of many types. This appears to be a case where the named inventors, laboring in relative isolation, were simply not aware of pertinent developments in the prior art.

One early reference to recognize the Al / Ti / Pt / Au metal stack as a semiconductor contact was Murarka *et al.*,[1] published in 1978 and titled "*Investigation of the Ti-Pt Diffusion Barrier for Gold Beam Leads on Aluminum*". (A20207.) Murarka explained that, to avoid detrimental interaction between Aluminum and Gold, a Ti-Pt diffusion barrier was advisable. In Murarka's words:

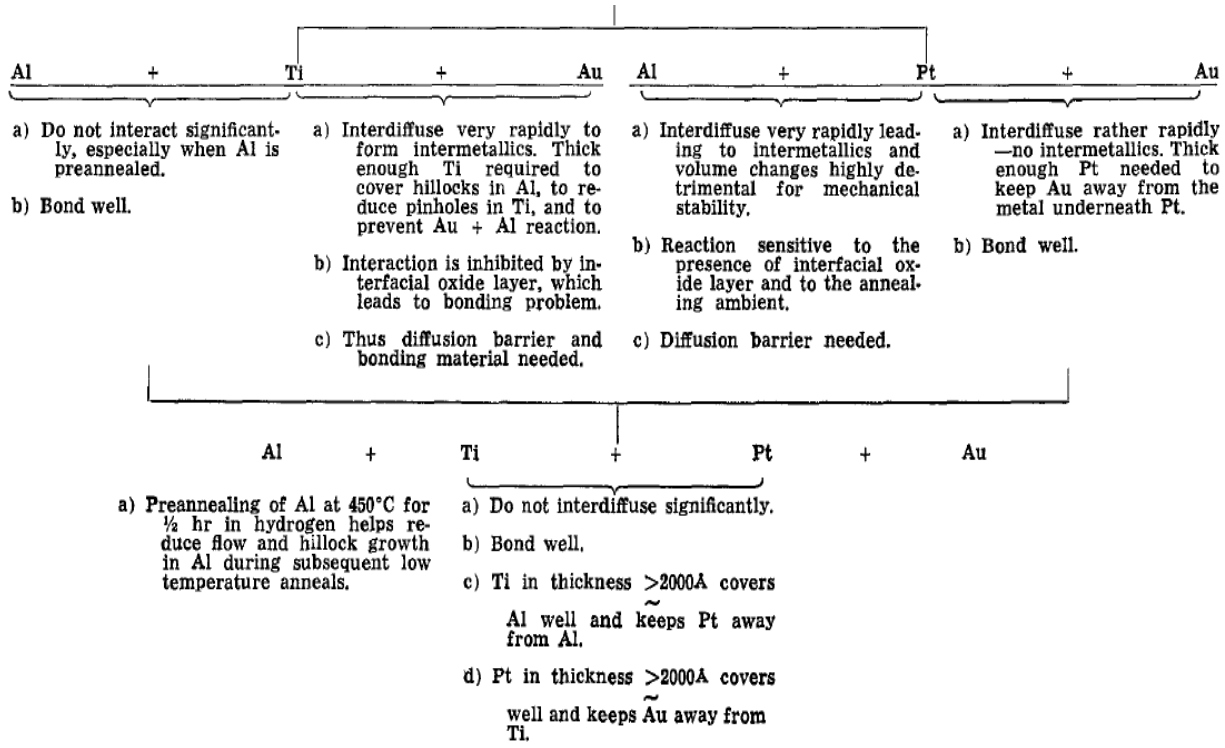
> To avoid gold-aluminum interactions, a suitable diffusion barrier between Al and Au has to be provided…. The results of both Melliar-Smith and Polito and DeBonte *et al.* indicate that a Ti-Pt diffusion barrier between Al and Au would be a good choice.

(A20207.)

Murarka further explained why each layer in the Al / Ti / Pt / Au

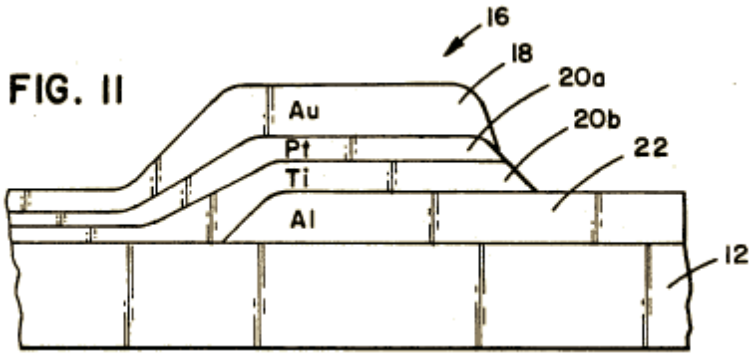
[1] Murarka was submitted as part of the Background of the petition for inter partes review (A00077) and was cited by the Board (A00006; A00037).

stack should be in the position now claimed by the '215 patent. Murarka's explanation is summarized in the chart on page 161 of his paper, reproduced below:



(A20212.) The top row of Murarka's chart shows (in 1978) the adverse reactions to be expected if the layers are placed out of the order now claimed by the '215 patent. The bottom row shows the beneficial interactions of the claimed order. Murarka concluded by predicting the "key breakthrough" that would—22 years later—be claimed in the '215 patent. In Murarka's words: "**[w]e now understand the need of a Ti-Pt (with at least ~2000Å of each) diffusion barrier between Al and Au.**" (A20212 (emphasis added).)

Nichia's petition provided several other examples of the Al / Ti / Pt / Au stack in the prior art that followed Murarka's 1978 publication. For example, U.S. Pat. No. 5,182,420, issued in 1993, shows in Fig. 11 (at right) the Al / Ti / Pt / Au contact on Silicon. (A20219.)



Nichia also provided examples of the Al / Ti / Pt / Au contact stack on n-type III-V semiconductors, such as those claimed in the '215 patent. The 1994 Kawamura reference[2] (using n-type Gallium Arsenide, a III-V semiconductor), explained that Al / Ti / Pt / Au was one of several "regular" contact types that could be used. In the words of Kawamura:

> For the conductive layer(s) comprising the electrode, **any regular metal** may be used **including**, for example, W, Zn, Au, Al, Ge/Au/Ni, AuGe/Ni/Au, Ti/Pt/Au, **Al/Ti/Pt/Au**, Ti/Pt, AgGe/In/Ag, or the like. Any type that is capable of forming an ohmic electrode is fine.

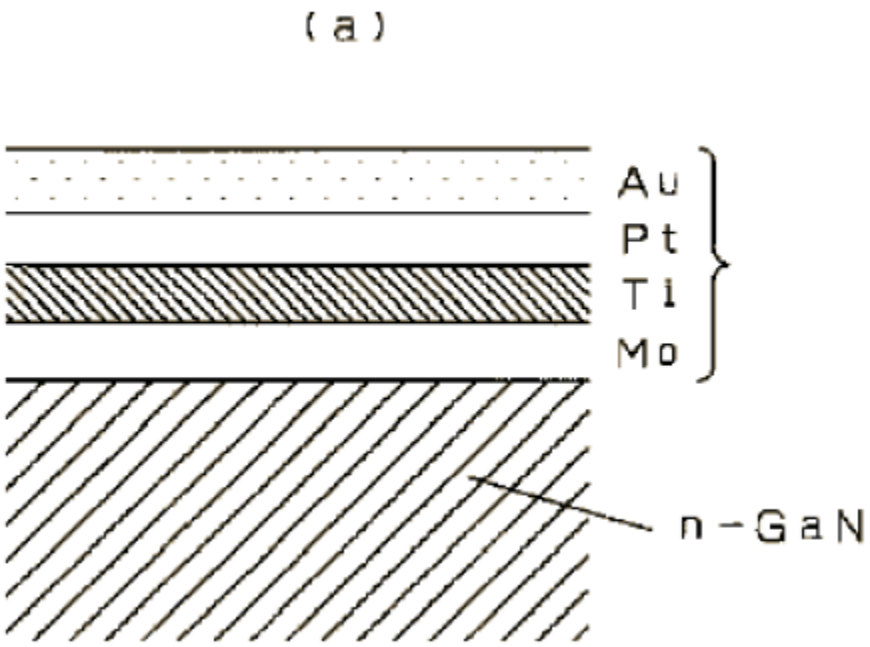
[2] JP H06-37036 (A20224-31).

(A20228, ¶15 (emphasis added).)

Likewise, the principal reference applied by the Board — Kidoguchi[3] — teaches the Al / Ti / Pt / Au contact stack on n-type Gallium Nitride (abbreviated "n-GaN"). (A00226-27, ¶¶31-33.) That Al / Ti / Pt / Au was known as a semiconductor contact in the prior art was likewise conceded by Emcore's expert, Prof. Goorsky, although he disputed the applicability of the prior art. (A20022-23.)

Using the known status of the Al / Ti / Pt / Au contact, Nichia's petition for inter partes review put forward several grounds of unpatentability. Grounds 3 and 4 of the petition were based on the Kidoguchi reference. Kidoguchi teaches an n-type Gallium Nitride substrate, having a four-layer contact. The contact is shown in Fig. 14(a):

[3] JP10-256645, published in 1998.



(A00233.) The above structure is identical to the contact that results from the '215 patent method, except that the bottom metal layer is Molybdenum, not Aluminum. (A00022-23.) However, Kidoguchi states that Aluminum can be substituted for Molybdenum:

> The example that uses Mo as the n-GaN contact metal has been explained with reference to Fig. 14, but other metals such as W, Ta, Ti, or **Al for example, may also be used**.

(A00226-27, ¶33 (emphasis added).) The Board found, not surprisingly, that this teaches that Aluminum can be used in place of Molybdenum. (A00023.) Emcore does not challenge this finding here.

Kidoguchi also explains that—as Murarka had shown in 1978—the middle Ti and Pt layers were useful as diffusion barriers. (A00226,

¶32.) Kidoguchi further explains why Ti and Pt should be in the positions claimed by the '215 patent. (A00226.) In Kidoguchi's words:

> In Fig. 14(a), **Pt (platinum) is inserted** at the lower section (the n-GaN side) of Au (gold). This **restrains the excessive diffusion** of Au and suppresses the increase in the contact resistance. In FIG. 14(a), Ti (titanium) is further inserted in the lower section of the Pt. Pt's work function, 5.65eV, is also high, which might induce an increase in the contact resistance due to the diffusion. The **insertion of Ti suppresses the diffusion** of Pt.

(A00226, ¶32 (emphasis added).) The Board agreed that Kidoguchi taught the same barrier layers, in the same positions, for the same purpose of suppressing diffusion. (A00018.)

With Kidoguchi, the Board was thus presented with a prior art reference that—within its four corners—expressly taught every element of claim 1 except "annealing." The question before the Board, therefore, was whether it would have been obvious to perform an annealing step on Kidoguchi's contact. (A00026.)

The Board had a wealth of evidence supporting the obviousness of annealing. The evidence showed that annealing was used on approximately 90% of all prior art contacts. (A00147, ¶29.) The

evidence also showed that annealing could be used to improve the properties (like contact resistance and thermal stability) of semiconductor contacts having an Aluminum base layer. For example:

- Professor Schubert (Nichia's expert) testified that "[i]n 1999-2000, it was very common to anneal contacts to an n-type IIIV semiconductor. In my experience, most such contacts (perhaps around 90%) were annealed. Non-annealed contacts were a kind of exception." (A00147, ¶29.) *This testimony was not disputed by Emcore*.
- The prior art Shibata reference *recommended annealing* of a semiconductor contact stack having a Gold top layer, a Ti diffusion barrier and an Aluminum base layer on n-type Gallium Nitride, to achieve a contact with low contact resistance, good thermal stability and wire bonding characteristics. (A00236; A00241, ¶¶26-28.) Professor Schubert's testimony supported the conclusion that Shibata recommended annealing. (A00160-61, ¶65; A00164-65, ¶74.)
- The prior art Fujimoto reference *recommended annealing* an Al / Pt / Ti / Au contact. (A00192, 16:36-49; A00193, 18:30-45; A00194,

20:13-17.) Fujimoto taught that its method produced low contact resistance and enabled good wire bonding. (A00186, 3:54-57.) Professor Schubert's testimony supported the conclusion that Fujimoto recommended annealing. (A00148-49, ¶¶32-33; A00160-61, ¶65.)

- Emcore's named inventors admitted in the Background section of their Provisional application that annealing was *typically* used for Aluminum-based contacts on n-type Gallium Nitride *to minimize the contact resistance*. (A00171-172.) Experts for Nichia and Emcore agreed on the meaning of these teachings in the Admitted Prior Art. (A20154-55, 155:19-156:19 (Prof. Goorsky); A00683-A00684, 283:9-284:8 (Prof. Schubert).)
- The prior art Luther reference taught that the contact resistance of Aluminum on n-type Gallium Nitride could be improved to $8x10^{-6}$ Ohm cm^2 (lower than that achieved by Emcore) through a process of annealing. (A00762-64.)

The evidence that annealing was an obvious step is not only substantial—it is overwhelming. The Board's conclusion that it would have been obvious to anneal Kidoguchi's contact should therefore be

affirmed.

SUMMARY OF THE ARGUMENT

Emcore waived its procedural challenge to Luther by not presenting it to the Board. Emcore did not follow the required two-step objection procedure specified in 37 C.F.R. § 42.64. Emcore also failed to articulate its new statutory argument to the Board by any other means.

Emcore's new statutory argument to exclude Luther has no basis in the text of 35 U.S.C. § 312, and would bring § 312 into conflict with other provisions of the statute, including those providing for discovery. The PTO has already interpreted the statute contrary to Emcore's position here, and the PTO's interpretation is entitled to *Chevron* deference. Even without Luther, the conclusion of obviousness is supported by strong evidence beyond Luther.

The Board correctly construed the claim terms "annealing" and "base layer." Emcore asserts error, but cannot decide what the correct constructions should be. Assuming Emcore's constructions are the same ones it offered below, the Board correctly found them in conflict with the ordinary meanings of "annealing" and "base layer," and Emcore does not dispute this. The '215 patent lacks any clear intent to

override the ordinary meanings of "annealing" and "base layer." Even if the Board had adopted Emcore's proposed constructions, it would not have changed the outcome.

The Board articulated a convincing motivation to combine. The Board found that Kidoguchi taught everything in claim 1 except annealing. The Board correctly found that several other prior art references taught annealing similar contacts, in order to improve those contacts. The Board correctly credited Nichia's expert and the objective language of the prior art over Emcore's expert.

STANDARD OF REVIEW

A. Obviousness.

"Whether a claimed invention is unpatentable as obvious under § 103 is a question of law based on underlying findings of fact." *In re Gartside*, 203 F.3d 1305, 1316 (Fed. Cir. 2000). Findings of fact are reviewed for "substantial evidence," *id.*, which requires this Court to ask whether "a reasonable person might find that the evidentiary record supports the agency's conclusion." *On-Line Careline, Inc. v. Am. Online, Inc.*, 229 F.3d 1080, 1085 (Fed. Cir. 2000).

B. Claim Construction.

In re Morris, 127 F.3d 1048, 1055 (Fed. Cir. 1997) holds that because

"the PTO . . . give[s] claims their 'broadest reasonable interpretation,' . . . [t]he question [on appeal] is whether the PTO's interpretation of the disputed claim language is 'reasonable.'" This same rationale applies to inter partes review. *See* 37 C.F.R. § 42.100(b). To the extent claim construction involves any underlying factual findings, the Board is entitled to at least as much deference—and probably more due to its technical expertise—as district courts. *See* 35 U.S.C. § 6(a) (requiring Board judges to have "competent legal knowledge and scientific ability"); Brief for the United States as Amicus Curiae Supporting Neither Party at 10-24, *Teva Pharms. USA, Inc. v. Sandoz, Inc.*, No. 13-854 (June 18, 2014), 2014 U.S. S. Ct. Briefs LEXIS 2257, at *19-40 (arguing that factual findings by district courts in construing patent claims should receive deference on appeal).

ARGUMENT

I. EMCORE'S PROCEDURAL CHALLENGE TO LUTHER IS BOTH WAIVED AND MERITLESS

Emcore challenges the Board's consideration of the 1997 Luther reference—a reference against which Emcore offers no substantive argument. (Br. 33-35.) Emcore's procedural argument was waived below, and lacks any basis in law.

A. Emcore Waived Its Objection To Luther

Emcore never gave the Board the opportunity to consider whether Luther should be excluded based on its newly-minted statutory argument. Emcore's argument is thus waived. *See In re Baxter Int'l, Inc.*, 678 F.3d 1357, 1362 (Fed. Cir. 2012) ("[W]e generally do not consider arguments that the applicant failed to present to the Board.").

In order to raise the issue with the Board, Emcore needed to follow a two-step procedure set forth in the Code of Federal Regulations: First, the Code required Emcore to serve Nichia with its objection to Luther. *See* 37 C.F.R. § 42.64(b)(1). Such an objection must "identify the grounds for the objection with sufficient particularity to allow correction in the form of supplemental evidence." *Id.* Second, the Code specifies that "**[a] motion to exclude evidence must be filed to preserve any**

objection." 37 C.F.R. § 42.64(c) (emphasis added). Emcore does not challenge the validity or applicability of these regulations—which have the "force and effect of law." *DGR Assocs. v. United States*, 690 F.3d 1335, 1340 (Fed. Cir. 2012).

Emcore waived its objection at least because it did not comply with the two-step procedure. Emcore did serve a list of objections, including an objection that Luther was "irrelevant to the Trial because it is not a part of Ground 4." (A20233.) Although this is an objection to Luther, it is not the same objection Emcore advances here, and did not put Nichia on notice of Emcore's statutory argument.

Emcore then filed a motion to exclude, *but did not include any objection to Luther*. Rather, the motion was entirely directed to other issues. (A20238-54.) Emcore thus failed to comply with 37 C.F.R. § 42.64(c). By operation of that rule, Emcore's objection was not "preserve[d]." *Id.*

Furthermore, Emcore never took any other action to raise its § 312 argument with the Board. Emcore might have, for example, initiated a

conference call with the Board to discuss the issue,[4] but did not do so. Nor did Emcore articulate its new statutory argument during the oral hearing.[5] Emcore never gave the Board the chance to consider the statutory argument it asks this Court to consider, and has therefore waived the argument.

There are no exceptional circumstances in this case that would justify setting aside Emcore's waiver. Rather, the evidence strongly suggests that Emcore *intentionally waived* its objection to Luther, in order to avoid raising an issue of its own misconduct. Specifically, Nichia discovered during a deposition of Emcore's expert that Emcore had concealed the Luther reference, despite its duty of candor. It was likely to avoid *any discussion* of Luther that Emcore chose to forego a motion to exclude—a motion that Nichia would have had an

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[4] *See* Office Patent Trial Practice Guide, 77 Fed. Reg. 48756, 48758 (Aug. 14, 2012) ("The Board encourages the use of conference calls to raise and resolve issues in an expedited manner.").

[5] Emcore's vague "objection" at the oral hearing to "references beyond those in ground 4 … such as Luther or Murarka" (A00831) was not a "motion" as required by 37 C.F.R. § 42.64(c), and did not articulate the new statutory argument it presents here. At most, Emcore's oral objection was "only a skeletal or undeveloped argument" that this Court "may deem … waived on appeal." *Fresenius USA, Inc. v. Baxter Int'l, Inc.*, 582 F.3d 1288, 1296 (Fed. Cir. 2009).

opportunity to oppose in writing (A20278.) And where a party makes a *tactical decision* to forego a procedural option, waiver is the appropriate result. *See Litton Sys. Inc. v. Whirlpool Corp.*, 728 F.2d 1423, 1439 (Fed. Cir. 1984) ("A patent attorney should not be able … to choose one course of action within the PTO with the anticipation that, if later checked, he or she can always choose an alternate course of prosecution in a trial before a federal judge.").

Emcore's tactical decision to forego its objection to Luther arose from a series of events that began with the petition. As discussed above, the petition provided the Kidoguchi prior art reference, which taught an n-type GaN device having the same four-layer contact as the '215 patent. The petition further showed that it was obvious to anneal the contact of Kidoguchi, in turn rendering claim 1 of the '215 patent obvious. (A00107-15.)

In response to this argument, Emcore argued that the prior art taught away from using an Aluminum base layer with annealing. (A00277.) This argument was surprising, because Emcore's own admitted prior art stated that Aluminum was "typically" used under annealing to achieve a minimum contact resistance to n-GaN. (A00171-

172.) Furthermore, as the Board found, all five of the Ground 4 references discussed Aluminum base layers, and four of them taught annealing the contact. (A00017-21.)

After receiving Emcore's argument, Nichia conducted a brief prior art search to supplement the already strong evidence in its favor. That search quickly located the Luther reference. The Luther reference—published three years prior to Emcore's earliest filing date—reported that Aluminum could be used as a low-resistance contact to n-type GaN, and that annealing improved the contact resistance. (A00764.) Luther's teachings were directly inconsistent with Emcore's argument, as shown by the quotations in the table below from Emcore's Patent Owner Response (left side) and Luther (right side):

"Nichia's cited references, as well as other references at the time, **powerfully teach away from annealing an n-type contact with an Al base layer** for a III-V semiconductor."	"In conclusion, **Al …contacts to *n*-GaN** were investigated to determine the mechanism for Ohmic contact formation in contacts annealed between 400 and 600°C. **Al contacts improved after being annealed** at 600°C in Ar/4% H_2."
Emcore's Patent Owner Response (A00277 (emphasis added).)	1997 Luther Reference (A00764 emphasis added).)

Nichia presented the Luther article to Emcore's expert, Prof.

Goorsky, during deposition. (A20176-78, 177:25-179:2.) Professor Goorsky admitted that he had seen the Luther reference in his work on the inter partes review, in testimony that unfolded as follows:

> Q. I would like to hand you now what we have marked as Nichia Corp. 1030 [Luther]. I don't think you have a copy of that, Mike. At least I hope you don't. **Have you seen this article before?**
> **A. Yes.**
> Q. When did you see it?
> MR. TOMASULO [Emcore's attorney]: To the extent that calls for an answer that involves communications with counsel, I instruct him not to answer.
> Q. Are you not going to answer that question?
> MR. TOMASULO: Let me say this. If he's seen it other than when he was with working on this case.
> A. I have not seen it except for working -- well, I know the authors, and I know this work roughly that they've done. I don't know that I have seen it before working on this case.

(A20176-77, 177:25-178:18 (emphasis added).)

Although the Luther reference had never been raised in the proceedings, Emcore's expert was highly prepared to answer questions concerning Luther. For example, in response to a question regarding the meaning of two sentences in the "Abstract" of Luther, Emcore's

expert volunteered a wide-ranging, two-page answer covering numerous complex critiques of Luther. (A20178-81, 179:3-182:5.) Emcore's expert eventually conceded, however, that Luther reported the use of an Aluminum base layer under annealing to produce a low-resistance ohmic contact to n-type GaN. (A20181, 182:15-18; A20184, 185:3-9.)

The deposition thus revealed that Emcore knew of the Luther reference. Emcore's expert's level of preparation, as well as the content of Luther itself, give rise to the inference that Emcore considered the reference highly material.

Under these circumstances, Emcore had an obligation to disclose Luther. This obligation arises first from the fact that parties operating before the USPTO have a duty of candor and good faith to the tribunal. The regulations governing *inter partes* review reaffirm this duty:

> Parties and individuals involved in the proceeding have a duty of candor and good faith to the Office during the course of a proceeding.

37 C.F.R. § 42.11. Furthermore, the regulations also forbid a party from withholding evidence believed to be inconsistent with its own position. In such a case, the party has an obligation to serve the evidence on the opposing party. As stated in 37 C.F.R. § 42.51(b)(1)(iii)

(emphasis added):

> "Unless previously served, **a party must serve relevant information that is inconsistent with a position advanced by the party** during the proceeding concurrent with the filing of the documents or things that contains the inconsistency."

Emcore thus had a duty to bring forward the Luther article.

For purposes of this appeal, however, the issue is not whether Emcore committed misconduct. Rather, the question is whether Emcore *intentionally* chose not to raise its objection to Luther and thus waived the objection. The evidence strongly suggests that this is so. There is no doubt that Emcore knew of the Luther reference, did not disclose it before being caught in deposition, and considered it important. Furthermore, Emcore planned to object to Luther's introduction, because it served Nichia with an objection to the Luther reference. (A20233.) Emcore also understood the two-step procedure, because it served objections and timely filed a motion to exclude other evidence. (A20238-54.) Yet Emcore omitted the Luther issue from its motion to exclude. (*Id.*) A month later, during oral argument, Emcore again did not explain the basis of its objection. Instead, Emcore

conducted a stealth interrogation of the Board members, seeking quotable statements to use when it raised the objection in this Court.[6]

The most reasonable inference to draw from these facts is that Emcore intentionally avoided discussion of Luther below, fearing that such an objection would result in a discussion of its own concealment of Luther. Now, feeling itself beyond the Board's reach, Emcore seeks to resurrect its objection. But this course of conduct prevented the Board from considering Emcore's statutory argument, setting up an untenable situation for appellate review.

Emcore should be held to its tactical choices below, and this Court should find waiver of its procedural objection.

B. Emcore's Interpretation Of § 312 Is Wrong

Even if not waived, Emcore's newly-minted interpretation of 35 U.S.C. § 312 is contrary to both the overall statutory scheme *and* the plain language of § 312. It would also be contrary to the PTO's

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[6] *See* Br. 34 (quoting oral argument colloquy between Judge Chang and Emcore's counsel). Judge Chang was referring to the Petitioner's burden during the *preliminary* proceedings under 35 U.S.C. § 314(a). Indeed, in the final written decision under § 318, Judge Chang followed the PTO rule which permits consideration of reply evidence to the extent it responds to an opponent's arguments.

interpretation of the statutes, which—to the extent those statutes are at all unclear—is entitled to *Chevron* deference.

1. Emcore's Argument Conflicts With The Text of the Statute And The Overall Statutory Scheme

Emcore argues that no evidence supporting unpatentability may be entered in the trial phase, unless by motion under 37 C.F.R. § 42.123. (Br. 33-34.) This contention is mistaken. In fact, the statutes expressly allow for additional evidence to be submitted by multiple procedural avenues.

For example, 35 U.S.C. § 316(a)(5) gives the Director the power to issue regulations "setting forth standards and procedures for discovery of relevant evidence." *It is pointless to discover relevant evidence if the Board cannot consider it*. The statute expressly allows the cross-examination by deposition of party experts. *See id*. The deposition necessarily uses documentary exhibits, and results in a transcript. The transcript and exhibits are forms of evidence. The regulations *require* that the transcript be filed. 37 C.F.R. § 42.53(f)(7). If that evidence could not be submitted and considered, the statutory purpose of § 316(a)(5) would be frustrated. Here, Luther *was* entered as an exhibit to the deposition of Emcore's expert. (A20176-77, 177:25-178:1.)

Despite the existence of discovery in the trial phase, Emcore argues that the text of 35 U.S.C. § 312 places a restriction on the submission of evidence after the petition. Emcore's interpretation asks too much of the text. The plain language of § 312(a)(3) places an affirmative requirement on the petitioner *for the petition*, but places no restriction on the petitioner with regard to filings *after the institution decision*. That provision reads:

> **A petition** filed under section 311 **may be considered only if**—…(3) the petition identifies, in writing and with particularity, each claim challenged, the grounds on which the challenge to each claim is based, and the evidence that supports the grounds for the challenge to each claim….

35 U.S.C. § 312(a)(3) (emphasis added).

Section 312 sets forth an *initial* pleading standard for inter partes review. The initial pleading standard is there to facilitate the threshold decision ("institution decision") required to *begin* an inter partes review. This is clear from the language of § 314(a), which limits the deliberation concerning *initial* institution decision to "information presented in the petition … and any [patent owner preliminary] response." 35 U.S.C. § 314(a).

After the institution decision, however, there is a "trial" phase. *See* 37 C.F.R. § 42.2 ("*Trial* means a contested case instituted by the Board based upon a petition. A trial begins with a written decision notifying the petitioner and patent owner of the institution of the trial."). The trial phase allows both parties to take some discovery. 37 C.F.R. § 42.51. The trial phase ends with a "final written decision" under 35 U.S.C. § 318(a). In contrast to the *institution decision*, the statute governing the *final written decision* (§ 318) does not limit the Board to consideration of *only* evidence submitted with the petition:

> **If an inter partes review is instituted** and not dismissed under this chapter, the Patent Trial and Appeal Board **shall issue a final written decision with respect to the patentability of any patent claim challenged** by the petitioner and any new claim added under section 316(d).

35 U.S.C. § 318(a) (emphasis added). Thus, Congress knew how to limit the Board's consideration only to "information presented in the petition" (as it did in § 314(a)), but placed no such limitation in § 318.

Moreover, if Emcore's construction were adopted, it would unnecessarily bring § 312 into conflict with other portions of the inter partes review statutes, contrary to the "fundamental canon of statutory

construction that the words of a statute must be read in their context and with a view to their place in the overall statutory scheme." *Davis v. Mich. Dept. of Treasury*, 489 U.S. 803, 809 (1989).

For example, even Emcore is forced to acknowledge (Br. 34) that the statute give the Director the power to "**prescribe regulations**…(3) establishing procedures for the submission of supplemental information **after the petition is filed**." 35 U.S.C. § 316(a)(3) (emphasis added). The use of the word "supplemental" in this section indicates that the section applies at least to the petitioner, given that the patent owner submits no evidence with the petition.

Emcore attempts to fence in the Director's ability to authorize later filing of evidence by referring to 37 C.F.R. § 42.123. (Br. 34.) This regulation allows parties to file a motion to submit supplemental information. Subsection (a) of this regulation states:

> § 42.123 Filing of supplemental information.
>
> > (a) Motion to submit supplemental information. Once a trial has been instituted, a party may file a motion to submit supplemental information in accordance with the following requirements:

> (1) A request for the authorization to file a motion to submit supplemental information is made within one month of the date the trial is instituted.
> (2) The supplemental information must be relevant to a claim for which the trial has been instituted.

37 C.F.R. § 42.123(a). Subsection (b) provides for submissions after one month, and subsection (c) provides for submissions not directed to the patent claims currently at issue. *See id.*

Emcore's argument implies that § 42.123 is the *only* procedural avenue for submitting supplemental information. Emcore's implied reading of the regulations, however, is incorrect. Section 42.123 is not the *only* regulation allowing the submission of new evidence. Section 42.123 is directed to a specific avenue for submission of evidence, designed to allow relatively free supplementation within a limited time frame (within one month after the institution decision). This might include, for example, the submission of a newly-discovered anticipatory reference. After the one-month period specified in § 42.123, however, there are several other avenues for submitting further information. Each of these avenues has different restrictions and serves a different purpose.

As one example, 35 U.S.C. § 316(a)(5) allows the parties to conduct discovery. The discovery-generated evidence "must be filed … as an exhibit." 37 C.F.R. § 42.53(f)(7). Discovery takes place during discovery periods. Neither the Patent Owner's nor the Petitioner's discovery period closes before the expiration of the one-month deadline in 37 C.F.R. § 42.123(a).[7]

The regulations also contemplate a Petitioner reply brief after the Patent Owner's main response. *See* 37 C.F.R. § 42.23. Several regulations contemplate the submission of *evidence* with the reply—as Nichia did here with the Luther reference and the transcript of the deposition of Emcore's expert, Professor Goorsky. For example, 37 C.F.R. § 42.53(b)(1) states that "[u]ncompelled direct testimony may be taken at any time to support a petition, motion, opposition, or **reply**…." (emphasis added). In the comments accompanying the regulations, the PTO explained that:

> a reply may only respond to arguments raised in the corresponding opposition. Oppositions and **replies may rely upon appropriate evidence to support the positions**

[7] *See* Office Patent Trial Practice Guide, 77 Fed. Reg. 48756, 48757 (Aug. 14, 2012) (diagram showing periods).

> **asserted**. Reply evidence, however, must be responsive and not merely new evidence that could have been presented earlier to support the movant's motion.

Rules of Practice for Trials Before the Patent Trial and Appeal Board and Judicial Review of Patent Trial and Appeal Board Decisions, 77 Fed. Reg. 48612, 48620 (Aug. 14, 2012) (emphasis added). These explanatory comments are interpretive rules under the Administrative Procedure Act, 5 U.S.C. § 550 *et seq.*, because they "clarify or explain existing law or regulations." *Paralyzed Veterans of Am. v. West*, 138 F.3d 1434, 1436 (Fed. Cir. 1998). They were properly issued under 35 U.S.C. §§ 2(b)(2) and 316(a)(4).[8] And, as interpretative rules relating to matters of procedure, they "need not be published in the Code of Federal Regulations to be entitled to deference." *Cooper Techs. Co. v.*

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[8] 35 U.S.C. § 316(a)(4) broadly authorizes the Director to "prescribe regulations . . .establishing and governing inter partes review under this chapter."

35 U.S.C. § 2(b)(2) authorizes the Director to establish regulations that "govern the conduct of proceedings in the Office." Here, the PTO's rules permitting replies to rely upon responsive evidence are "procedural": they merely "alter the manner in which the parties present ... their viewpoints" to the PTO and do not "foreclose effective opportunity to make one's case on the merits." *JEM Broad. Co. v. FCC*, 22 F.3d 320, 326, 328 (D.C. Cir. 1994).

Dudas, 536 F.3d 1330, 1337 (Fed. Cir. 2008).

In contrast to the relatively free, but time-restricted supplementation allowed by § 42.123, the submission of reply evidence is *limited by content*. Specifically, only evidence that "**respond[s]** to arguments raised in the corresponding opposition" is allowed. Rules of Practice, 77 Fed. Reg. at 48620 (emphasis added). Here, the Board allowed the Luther article, and Emcore does not challenge the Board's implicit finding that Luther is "responsive." And even if Emcore had made such a challenge, the challenge would have been feeble: Emcore itself argues that Luther is the *most relevant* reference to its response. (Br. 35.)

Emcore's argument therefore conflicts with the text of § 312 and the overall statutory scheme, and should be rejected.

2. The USPTO's Interpretation Of The Inter Partes Review Statutes Is Entitled To Deference

To the extent Emcore's arguments cast any doubt over the interpretation of § 312, this Court "must respect the agency's construction of the statute so long as it is permissible" *FDA v. Brown & Williamson Tobacco Corp.*, 529 U.S. 120, 132 (2000); *see Chevron, U.S.A., Inc. v. NRDC, Inc.*, 467 U.S. 837, 843 (1984)). This is true

whether there is an ambiguity in § 312 itself, or whether an ambiguity arises because of a conflict between different statutory provisions. *See Scialabba v. Cuellar De Osorio*, 134 S. Ct. 2191, 2203 (2014).

Here, the PTO has, through its rulemaking power, interpreted the inter partes review statutes and its own implementing regulations to provide that "replies may rely upon appropriate evidence to support the positions asserted." Rules of Practice, 77 Fed. Reg. at 48620. The PTO's construction is reasonable because it allows a responding party to check its opponent's potentially unpredictable assertions, by relying on actual evidence rather than mere attorney argument, thereby ensuring that the Board's *adjudicative* fact-finding is based on the best evidence. *See* H.R. Rep. No. 112-98, pt. 1, at 46-47 (2011) (explaining that "[t]he Act converts inter partes reexamination from an examinational to an adjudicative proceeding, and renames the proceeding 'inter partes review.'").

C. Emcore's Objection Is Fruitless, Because Even Without Luther, The Evidence Supporting The Board's Decision Is Strong

Even without Luther, the ultimate legal conclusion of obviousness should be affirmed. Specifically, Shibata, Fujimoto and Admitted Prior

Art each provides strong, independent motivation to anneal Kidoguchi's contact. This will be explained below in §§ III.B.1 and III.B.2.

II. EMCORE'S CLAIM CONSTRUCTION ARGUMENTS ARE WITHOUT MERIT, AND WOULD NOT CHANGE THE OUTCOME

A. Emcore's Judicial Estoppel Argument Is Frivolous

Emcore argues that Nichia should be judicially estopped from arguing against low-resistance limitations. (Br. 32.) This argument is frivolous.

First, the argument was not made to the Board, and has thus been waived.

Second, judicial estoppel would at least require Nichia to have "*successfully* urged" a particular construction in court. *Data Gen. Corp. v. Johnson*, 78 F.3d 1556, 1565 (Fed. Cir. 1996) (emphasis added). Emcore argues in the very same brief, however, that "[f]or all three [constructions], the court credited Emcore's construction over that of Nichia." (Br. 15-16.)

Third, claim construction before the PTO is decided under a different—"broadest reasonable interpretation"—standard. This means that even if the constructions are different, it is not so simple to say that they are inconsistent. In fact, this is exactly the kind of case

where—if Emcore were correct in its reading of the '215 patent—the constructions *should* be different. Emcore argues for a change in the ordinary meaning of a claim term based on an overall impression of the "purpose of the invention." (Br. 20-22.) And while cases holding that claims should be limited in this fashion are possible to find, they are exceptions—found almost always in the context of a district court litigation, bound to the particular language of the specification at issue, and usually subject to debate among reasonable minds. Outside of these few exceptions, the more general rule is to *avoid* importing limitations from the specification.[9] This rule is doubly justified before the PTO, where the Patent Owner has the opportunity to amend claims, rather than merely insisting that the specification overrides the claims as written. *See Marine Polymer Techs., Inc. v. HemCon, Inc.*, 672 F.3d 1350, 1364 (Fed. Cir. 2012) (*en banc*) ("If, in reexamination, an examiner determines that particular claims are invalid and need amendment to be allowable, one would expect an examiner to require

[9] *See Philips v. AWH Corp.*, 415 F.3d 1303, 1323 (Fed. Cir. 2005) (*en banc*) ("[A]lthough the specification often describes very specific embodiments of the invention, we have repeatedly warned against confining the claims to those embodiments.").

amendment rather than accept argument alone.").

Finally, the Board's construction is not prejudicial to Emcore. The '215 patent is unpatentable even under the narrowest of Emcore's various proposed constructions. *See infra* §§ III.E (claim 15) and III.F (claims 6-10, 16-17).

B. Emcore's Proposed Constructions Are Not Clear

It is difficult for Emcore to accuse the Board of incorrectly construing the claims, when Emcore itself cannot articulate the construction it wants. Emcore does not formulate a proposed construction for this Court, and but rather takes several different, inconsistent positions about what should be included. Below, Emcore argued that "annealing" should mean "[h]eating the semiconductor structure sufficiently to form a contact with low resistance." (A00292.) So Emcore sought to add "low-resistance" to its construction. In its opening brief, however, Emcore argued that the construction should be limited to the concepts of *both* "low-resistance" *and* "reliable wire bonding." In Emcore's words:

> [T]he purpose of the invention is to provide a contact and a contact-forming method that both 'provide a low resistance ohmic contact' ***and*** 'allow reliable bonding of gold leads.'

> A00133. A claim construction that covers contacts that lack low resistance or reliable bonding pushes the claim outside the scope of the disclosed invention, and into the prior art.

(Br. 22-23 (emphasis in original).)[10] Emcore here admits that without a "reliable bonding" limitation the claims are invalid ("pushe[d]…into the prior art"). Yet Emcore never argued below that the claims should be so limited, and has thus waived a "reliable bonding" construction.

After adding "reliable wire bonding" to the apparent list of necessary additions to claim 1, Emcore then seems to focus on low-resistance:

> Lest there be any doubt about that conclusion, however, we now demonstrate that the *individual terms* 'annealing' and 'base layer' are themselves properly construed as limited to the fabrication of low-resistance contacts.

(Br. 28 (emphasis in original).)[11] In other places, Emcore argues for

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[10] *See* Br. 23 ("The written description unequivocally demonstrates that the invention is directed to the fabrication of low-resistance contacts with good wire bonding"); Br. 24 ("[T]he invention's fundamental purpose is to use known materials to produce contacts that, when annealed, feature both low resistance and good wire bonding.").

[11] *See* Br. 23 ("Absent a low-resistance limitation, the patent's claims are so divorced from the invention as to be meaningless."); Br. 28 ("Both

addition of the word "ohmic"[12] to "low-resistance":

> [the contact of the '215 patent] has two key features: it provides both 'a low-resistance, **ohmic** contact to the semiconductor' and 'excellent bonding to gold leads.'

(Br. 23 (emphasis added).) Then, after arguing for several pages for the inclusion of *one or more of* "low resistance," "reliable bonding" and/or "ohmic" in the claims, Emcore resurrects its proposed construction below, but focuses on a different part of the proposal, namely "*sufficient to form* a contact with low resistance," where the alleged distinction over the art is the word "form," not the phrase "low-resistance." (Br. 40-42.)

Emcore further confuses its position by implication. Emcore argues that "low-resistance" and "reliable wire bonding" are key features of the patent, and thus should be held to limit the claims. (Br. 22-23.) Emcore also argues, however, that "thermal stability" is a key

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'Annealing' and 'Base Layer' Are Properly Limited To The Creation Of Low-Resistance Contacts.").

[12] As the '215 patent explains, "ohmic" does not mean "low-resistance." (A00133, 1:32-39). "Ohmic" means that a system has a linear relationship between current and voltage. "Resistance" describes the *amount* of a voltage drop for a particular current.

feature of the patent—important enough to discuss under a separate heading in its brief, entitled "The Importance Of Thermal Stability." (Br. 7.) Inexplicably (given its line of reasoning), Emcore never sees fit to try to read *this* allegedly important feature into the claims.

As a result, it is not entirely clear what Emcore is arguing, nor what instructions should be given in Emcore's view if the case were to be remanded.

C. The Board's Constructions Were Correct

The Board correctly refrained from importing "low-resistance" limitations into the claim terms "annealing" and "base layer." Nichia does not actually know whether Emcore believes the claims should be limited to "reliable wire bonding." Emcore's later arguments, however, focus on the "low resistance" aspect of the construction, so Nichia will as well. The reasoning of this section would apply to the "reliable wire bonding" limitation because both constructions seek to import a desired goal of the invention into otherwise clear claim language.

The Board found that neither the word "annealing" nor the phrase "base layer" would have been *understood in the art* to include the concept of "low-resistance." (A00011; A00015.) The Board's findings

were based on substantial evidence. Regarding "annealing" alone, the Board found that the '215 patent admitted that annealing was used to produce other characteristics, like transparency. (A00013.) The Board also noted that a dictionary defined the term "to anneal" as "to heat (glass, earthenware, metals, etc.) to remove or prevent internal stress." (A00013.)

The Board further made several findings regarding the ordinary meanings of *both* "annealing" and "base layer." First, the Board found Emcore's "low resistance" construction inconsistent with Emcore's argument that the prior art taught annealed contacts with high resistance. (A00011; A00015.) Second, the Board noted that adding "low resistance" in any form to claim 1 would render claim 15 superfluous (A00012.) Third, the Board found that low resistance was merely "desirable" in the '215 patent, and not an integral part of the process for forming a contact. (A00015.) Emcore argues here that the discussion of the "desirability" is found in the Background of the '215 patent, and thus does not refer to the "invention." (Br. 27.) Four pages earlier in its brief, however, Emcore relies on *the very same passage of the Background* to support its low-resistance argument. (Br. 23-24.)

In fact, Emcore agrees with the Board's finding that the *ordinary meanings* of "annealing" and "base layer" did not include the concept of "low resistance." For example, Emcore states that:

> Under the Board's approach, **absent an express definition** in the specification, 'annealing' should be construed to have **the exact same meaning [as] if the patent did not exist**.…The Board made the same error with 'base layer'.

(Br. 26 (emphasis added).) Indeed, Emcore had no choice but to acknowledge that the ordinary meanings of the terms "annealing" and "base layer" implied nothing about resistance. Emcore's hand was forced because it argued that the prior art taught away from annealing an Aluminum base layer. (*E.g.*, Br. 10 ("Foresi Finds That Al **Base Layers** Show **Poor Contact Resistance**, Which **Increased On Annealing**.") (emphasis added).) This argument would be foreclosed if the prior art—through the mere mention of the terms "annealing" or "base layer"—communicated the achievement of low resistance.

Therefore, instead of contesting the Board's findings concerning the ordinary meanings of "annealing" and "base layer," Emcore argues that the '215 patent should be read to *change* those ordinary meanings. (Br. 25-27.) Yet in order to "deviate from the plain and ordinary meaning of

a claim term to one of skill in the art, the patentee must, with some language, indicate a clear intent to do so in the patent." *Hill-Rom Servs., Inc. v. Stryker Corp.*, 755 F.3d 1367, 1373 (Fed. Cir. 2014).

The '215 patent does not indicate such a "clear intent." Instead, the '215 patent uses the terms "annealing" and "base layer" separately from the concept of "low resistance." Quite reasonably, "annealing" is treated as a process step, and "low resistance" the outcome of the process. (A00130, Abstract.) The specification even recites a temperature range 400-600°C to achieve low resistance. (A00134, 4:43-46.) Outside of this range, the specification makes no claim to low resistance.

Similarly, adding "low resistance" to "base layer" makes little sense. A "base layer" is a thing, while "low resistance" is a characteristic that the thing may (or may not) have. (A00133, 2:23-39.) The '215 patent provides evidence that "base layers" often do not have "low resistance." For example, the claimed method expresses an ordering of its steps (by using the linking term "then" between steps), and the "base layer" is referred to *before* the annealing step. (A00135.) This is significant because, according to Emcore, "low resistance" comes about first when the annealing step is carried out. (Br. 21.)

Likewise, Emcore itself instinctively uses the term "base layer" divorced from the concept of "low resistance." (Br. 47 ("Kidoguchi, for example, is directed to **high-resistance contacts** for use in lasers, focuses primarily on using a **base layer of molybdenum**….") (emphasis added).) Emcore's expert, Prof. Goorsky, did the same. (A20145, 146:1-4.)

It *is* correct that low resistance is desirable in some contexts. (A00015.) Emcore goes so far as to argue low resistance as one of several "purposes" of the patent. But Emcore's characterization is insufficient to limit otherwise clear claim terms. As this Court has held:

> The court's task is not to limit claim language to exclude particular devices because they do not serve a perceived 'purpose' of the invention…. An invention may possess a number of advantages or purposes, and there is no requirement that every claim directed to that invention be limited to encompass all of them.

E-Pass Techs., Inc. v. 3COM Corp., 343 F.3d 1364, 1370 (Fed. Cir. 2003). Nor is this a case where the patent describes a feature as a part of the entire "invention." Rather, each use of the term "invention" in the '215 patent is carefully preceded by phrases like "one aspect of" or

"one embodiment of." (*E.g.,* A00133, 2:23, 2:33.) The '215 patent even repudiates the argument that Emcore now seeks to make by stating:

> [T]he foregoing description of the preferred embodiments should be taken by way of illustration rather than by way of limitation of the present invention.

(A00135, 5:53–6:2.)

When the named inventors wanted to limit the claims by resistance, they did so expressly. As the Board found, claim 15 recites a contact resistance range (10^{-5} Ωcm^2 or less). (A00012.) According to both Emcore and Nichia, that range captures every contact resistance that would have been considered "low" in the relevant timeframe. (Br. 7, 10, 13, 40, 42 (Emcore); A00157, ¶55 (Nichia).) The upper endpoint of the range is simply the approximate boundary between "low" and "high" resistance. (A00157, ¶55.) The Board correctly found that adding "low resistance" to claim 1 would render claim 15 superfluous. (A00012.)

Emcore seems at first to dispute this. (Br. 30) ("the Board [found] that including a low-resistance limitation in 'annealing' and 'base layer' would render claim 15 'insignificant, if not wholly superfluous.' A00012. That conclusion was incorrect."). Later in its brief, however, Emcore concedes that "claim 15 separately claims low resistance." (Br. 43.)

Implicitly acknowledging the claim differentiation problem in at least one part of its brief, Emcore argues that its evidence is so strong that the collateral damage to claim 15 should be ignored. (Br. 30-31.) In this case, however, claim 15 serves as further evidence that named inventors did not consider—and their disclosure did not treat—the concepts of "annealing" and "base layer" to be limited to low resistance. Otherwise, there would have been no need to include claim 15. Emcore's vacillating references to the purposes of the patent do not overcome the presumption of claim differentiation.

Finally, Emcore's claim construction arguments would not change the outcome. As discussed below, the result of Emcore's construction is to merge claim 15 into claim 1. The Board, however, correctly found claim 15 obvious. *See infra*, § III.E.

III. THE BOARD'S OBVIOUSNESS FINDINGS ARE WELL-SUPPORTED BY RECORD EVIDENCE

Emcore re-argues a series of Board fact findings, concluding with the assertion that there is no reason to anneal Kidoguchi's contact. This Court reviews such findings for substantial evidence. *See In re Gartside*, 203 F.3d 1305, 1316 (Fed. Cir. 2000). In this case, the Board has the weight of the evidence firmly on its side.

As discussed above, Ground 4 of the petition demonstrated that it was obvious to anneal Kidoguchi's Al / Ti / Pt / Au contact. In this light, it is helpful to address Emcore's myriad arguments in two groups: (A) arguments asserting that Kidoguchi is not a proper starting point, and (B) arguments asserting it would not have been obvious to apply the common technique of annealing to Kidoguchi's contact.

A. The Board Did Not Err By Crediting The Actual Language Of Kidoguchi

Emcore makes one argument concerning Kidoguchi, namely that "Kidoguchi is **expressly directed to** the fabrication of ***high*-resistance contacts**." (Br. 42 (emphasis added).) Because of this, Emcore argues that Kidoguchi would not meet its proposed "low resistance" limitation (or alternately claim 15), and would not be an appropriate starting point for obviousness.

Emcore has a curious understanding of the phrase "expressly directed to." Emcore supports its argument that Kidoguchi is "expressly directed to the fabrication of high-resistance contacts" with a general citation to Kidoguchi ("A00226-28"). Within those pages, however, Kidoguchi states that it is concerned with *lowering* the resistance of its n-side contact. In fact, Kidoguchi explains that it uses the same Ti / Pt

diffusion barrier as the '215 patent (Emcore's "key to the invention"), *in order to reduce diffusion and lower the contact resistance*. For example, Kidoguchi at A00226 explains—contrary to Emcore's characterization—that high contact resistance is *undesirable* due to a "loss of reliability":

> Au diffuses into the n-type GaN contact layer to **induce an increase in the contact resistance** causing the drive voltage to increase. **This results in a considerable loss of reliability**.

(A00226, ¶31 (emphasis added).) Kidoguchi continues by explaining that its Ti / Pt barrier helps to reduce diffusion and to lower the contact resistance:

> In Fig. 14(a), Pt (platinum) is inserted at the lower section (the n-GaN side) of Au (gold). This **restrains the excessive diffusion** of Au and **suppresses the increase in the contact resistance**. In FIG. 14(a), Ti (titanium) is further inserted in the lower section of the Pt. Pt's work function, 5.65eV, is also high, which **might induce an increase in the contact resistance due to the diffusion**. The insertion of Ti **suppresses the diffusion** of Pt.

(A00226, ¶32 (emphasis added).)

Emcore's argument to this Court is thus nothing more than a misrepresentation of the content of Kidoguchi. Likewise, the Board's

rejection of Emcore's argument involved nothing more than crediting the *actual language* of the reference over its imagined content. Because of this, the Board's decision on this issue is supported by substantial evidence.

B. The Board's Finding That There Was Motivation To Use Annealing Is Supported By Strong Evidence

"The presence or absence of a motivation to combine references in an obviousness determination is a pure question of fact." *In re Gartside*, 203 F.3d 1305, 1316 (Fed. Cir. 2000)

Emcore acknowledges that without a "reliable bonding" limitation (which it waived), its claims are "pushe[d] … into the prior art." (Br. 22-23.) Emcore further acknowledges that three references relied on by the Board "purport to teach the annealing of an aluminum base layer and a gold top layer to produce a low-resistance contact." (Br. 18.) Emcore urges this Court, however, to vault over these "purported" teachings on poles constructed from rickety inferences.

In so doing, Emcore mistakes the nature of this appeal. Emcore is not entitled to have this Court re-weigh from scratch its convoluted theories against the plain language of the references. The Board already did that, and found against Emcore. Rather, Emcore's

challenge on appeal is to show that the Board's decision was not supported by substantial evidence. By beginning with the admission that three references of record "purport to teach the annealing of an aluminum base layer and a gold top layer to produce a low-resistance contact," and conceding that its claims are "pushe[d]…into the prior art" absent a claim limitation that it failed to argue below, Emcore's appeal is hopeless.

Beyond Emcore's admissions, however, there is no question that the Board's judgment was supported by substantial evidence. The petition for inter partes review put forward two grounds of unpatentability involving Kidoguchi: Grounds 3 and 4. Ground 3 asserted that claims 1 and 11-14 were anticipated by Kidoguchi. (A00102-15.) Although Kidoguchi did not *expressly* teach annealing, Nichia demonstrated that annealing was so common in the prior art that it would have been immediately envisaged by a person of ordinary skill. Nichia cited to the testimony of Professor Schubert—author of the treatise *Light Emitting Diodes*[13]—who explained that approximately 90% of prior art contacts were annealed. (A00147, ¶29.) Emcore has never disputed this

[13] (A00138, ¶5).

testimony.

Professor Schubert further explained that:

> [U]pon reading JP '645 [Kidoguchi], a person of ordinary skill in 1999-2000 would have immediately known that the contact was either annealed or not annealed, and that most such contacts were annealed at temperatures at or above 400°C, as explained above in ¶29.

(A00160, ¶63.)

Acknowledging, however, that annealing was not *expressly* disclosed in Kidoguchi, Nichia also argued that it would have been—at the very least—obvious to anneal the contact of Kidoguchi. (A00107-15.) In support of this, Nichia pointed to its arguments under Ground 3, (A00107), and provided four additional references (Shibata, Fujimoto, the Admitted Prior Art and Nakamura) that taught annealing Aluminum-containing, n-side GaN contacts. (A00108-09.) Nichia argued that "**annealing at 400-600°C was extremely commonly used to lower contact resistance** for n-side contacts on III-V semiconductors at the time the Provisional application was filed." (A00108 (emphasis added).) Nichia explained why each of the supporting references recommended annealing. (A00108-09.) Nichia also explained that,

under *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 417 (2007), annealing was obvious as a commonly used technique that could be applied to improve semiconductor contacts, without surprising results. (A00109-10.)

Professor Schubert supported Nichia's argument by testifying that "**numerous prior art references taught that it was advisable to anneal contacts** such as the one described in JP '645 [Kidoguchi] at temperatures above 400°C." (A00160-61, ¶65 (emphasis added).) Professor Schubert explained how each reference supported his conclusion. (*Id.*) These references, and Emcore's critiques, will be discussed in turn.

1. Shibata And Fujimoto Provide Substantial Evidence For The Board's Judgment

Shibata and Fujimoto support the Board's conclusion. Shibata's disclosure is very similar to the '215 patent. Shibata discloses a GaN-based semiconductor. Like the '215 patent, the n-side contact of Shibata has an Aluminum base layer and a Gold top layer. (A00236.) Like the '215 patent and decades of prior art before it, Shibata recognizes that Aluminum and Gold interact poorly upon annealing. (A00241, ¶28.) Shibata's solution—like the '215 patent's—is to use a

barrier layer (in this case Ti alone) between Aluminum and Gold to prevent diffusion. (A00241.) Shibata recommends annealing at 600°C, to arrive at a contact with contact resistance of 10^{-5} Ωcm^2, with excellent wire bonding characteristics and thermal stability. (A00241, ¶27.)

Emcore appears to have no quibble left with the express teachings of Shibata. Below, Emcore argued that Shibata taught away from using Gold and Aluminum in the same contact, because "annealing may cause the contact's top layer to be dysfunctional as a bonding pad." (A00274.) The Board saw through Emcore's argument, however, finding that Shibata taught the use of a diffusion barrier to solve the problem. (A00030.) Emcore does not repeat this argument on appeal.

Emcore's expert also testified below that Shibata's contact resistance of 10^{-5} Ωcm was ambiguous, because of an error in the units used. Emcore's expert implied that the units "Ωcm" did not represent a "contact resistance," but more likely a "transfer resistance" (A00347-48), which he stated was commonly used to characterize contacts. (A00338-39, ¶30.) Emcore mentions this issue on appeal, but does not seek review. (Br. 11.) In any case, the Board resolved this issue against Emcore, finding that Shibata's use of Ωcm instead of Ωcm^2 was a

typographical error that would have been recognized by a person of ordinary skill. (A00031.) The Board's findings were well-supported by (a) the testimony of Professor Schubert (A00168, ¶88), (b) the fact that Shibata actually says it is referring to a "contact resistance" (A00241, ¶27), and (c) the fact that the parties agree that 10^{-5} was a middle-of-the-road contact resistance for that timeframe.[14]

Left with no other argument, Emcore again resorts to misrepresenting the content of a reference. Emcore argues that Fujimoto later demonstrated that Shibata's work was inaccurate. Emcore states:

> consistent with all the pre-Shibata prior art, Fujimoto found that Shibata's Al/Ti/Au contact 'invited an increase in contact resistance of the electrode' and '**degrade[d] wire bonding' in the Au top layer**.

(Br. 11 (emphasis added).) As support, Emcore quotes on page 37 of its brief the passage of Fujimoto at col. 2, ll. 18-29. That passage of Fujimoto, however, *does not discuss Shibata*. Shibata is JP-8-274372.

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[14] Br. 7, 10, 13, 40, 42 (Emcore); A00157, ¶55 (Nichia); *see also* A00281 (Emcore's Patent Owner Response); A00809, 34:17-23 (Oral Argument Transcript).

(A00236.) The passage that Emcore lifts from Fujimoto discusses only JP-3-252175 and 7-240508.

There *is* a section of Fujimoto that discusses Shibata. (A00185, 2:32-34.) There, however, Fujimoto says—directly contrary to Emcore's portrayal to this Court—that Shibata's approach *improved* the degradation problem, reporting that it "certainly made wire bonding possible." (*Id.*)

While Fujimoto does say that Shibata's approach improved wire bonding but also "invited an increase in contact resistance of the electrode" (*id.*), the Board found that this would not have dissuaded a person of ordinary skill from annealing Kidoguchi's Al / Ti / Pt / Au contact (A00031-32.). This finding was well-supported. As the Board noted, the statement in Fujimoto is "vague and ambiguous." (A00031.) The word "increase" implies a comparison with something, but Fujimoto never says what the baseline is. Furthermore, the phrase "inviting an increase" is vague—in the sense that "inviting an increase" is not the same thing as having the increase actually show up. In that respect, it is not clear whether Fujimoto's statement is experimentally based, or instead reflects the inventors' theoretical beliefs about the potential

tendencies of Shibata's contact. If the statement is experimental, it is not clear whether the increase appears only in occasional bad batches, and if so, with what frequency.

Emcore argues that the Board improperly shifted the burden of proof to Emcore, effectively requiring Emcore to reproduce Fujimoto's experimentation. Emcore, however, misreads the Board's decision. The Board noted that "Emcore and its expert … did not provide any experimental data regarding the alleged experiment conducted by Fujimoto." (A00031.) Here, the Board is not saying that Emcore has the burden of proof. The Board states quite clearly that the burden rested with Nichia. (A00064.) Rather, the Board is finding that Emcore's evidence is not sufficiently *credible*. The Board had no way to determine what experimentation was done or what conclusions could be drawn therefrom. Moreover, if Emcore thought Shibata would not work, *Emcore was perfectly capable of testing Shibata*. Emcore chose not to do so. Rather, as the Board found, Emcore chose to "rely on a vague and ambiguous sentence in the background of Fujimoto," (A00031) presumably because that was the best Emcore could hope for. Alleging that Shibata was not enabled while at the same time refusing

to test Shibata did nothing to help Emcore's credibility.

The Board's decision that the statement about "inviting an increase" would not have dissuaded a person of ordinary skill from annealing the contact of Kidoguchi was also supported by other evidence. For example, later in the Fujimoto patent, Fujimoto reports improving on the state of the art in the Background by building an Aluminum-based, Gold-topped n-side contact to GaN. Fujimoto teaches that this electrode is "preferably annealed." (A00192, 16:45-46.) To deal with the degradation problem, Fujimoto used Ti and Pt barrier layers. The Board found that Fujimoto's method resulted in "low contact resistance and good wire bonding." (A00029 (citing Fujimoto, 2:56-58, 3:53-57).) Whatever Fujimoto says about the prior art, it is very difficult to read Fujimoto's statement that "*[t]he electrode is preferably annealed*" (A00192, 16:45-46) as anything but an *express recommendation to perform annealing*. Here, it makes no difference whether Fujimoto teaches "a causal relationship" between annealing and contact resistance. (Br. 40.) The fact remains that Fujimoto *recommends* annealing of an Aluminum-based, Gold-topped contact.

Emcore also argues that Fujimoto reports a contact resistance of 10^{-4}

Ωcm^2, which allegedly would have been viewed as poor in the relevant timeframe. Here, Emcore embraces Professor Schubert's testimony that:

> In 1999-2000, a contact resistance of 10^{-5} Ωcm^2 would simply have reflected the approximate dividing line between a desirable contact and an undesirable contact.

(A00157, ¶55.) Thus, argues Emcore, Fujimoto's contact resistance would have been viewed as poor. But Emcore's argument neglects three important factors. First, Fujimoto itself *recommends* annealing. (A00192, 16:44-45.) Fujimoto's very direct and express statement ("preferably annealed") cannot be taken as a teaching away. And even if there were any doubt on the point, it cannot be said that the Board's finding, based on the evidence, was unreasonable. Second, the parties agreed, and the Board found, that the 1990s was a time of intense development in the GaN semiconductor arts. (A00334, ¶18.)[15] All aspects of the surrounding technology improved (*id.*), leading to better methods throughout the field. "Good" in 1993 (or 1997, when Fujimoto was first filed) was likely not the same as "good" in October of 2000,

[15] *See* A20084, 85:8-23.

when Emcore's provisional application was filed. Third, contact resistance, like the strength of an earthquake or the intensity of sound, is a parameter where some variation over wide ranges is expected. (A00706, 306:2-15.) For example, Emcore's own experimentation underlying the '215 patent produced a 360% variation in contact resistance. (A20282.) And that was *within the same experiment*, *conducted by the same person*, presumably using the *same materials and the same equipment*. Thus, the Board had a solid basis on which to credit Fujimoto's express recommendation to perform annealing over Emcore's multistep teaching away argument.

The Board was well-justified in crediting Shibata's and Fujimoto's express recommendations to anneal their Al-based, Au-topped contacts over Emcore's multistep inferences relying on vague evidence. As the Board correctly found:

> Given that Shibata and Luther show that others have achieved low contact resistance and good thermal stability by annealing Al contacts to n-type GaN, the testimony of Emcore's expert—that one of ordinary skill in the art would not have understood Shibata as teaching a low resistance ohmic contact to n-type GaN (Ex. 2001 ¶47)—is entitled little weight.

(A00032.)

2. The Admitted Prior Art Independently Provides Substantial Evidence To Support The Board's Conclusion

The Admitted Prior Art independently provides substantial evidence to support the Board's conclusion that it was obvious to anneal Kidoguchi's contact. Specifically, the Admitted Prior Art teaches that annealing was *typically* used to achieve *minimum contact resistance* for Aluminum-based contacts to GaN.

The Admitted Prior Art of interest here is found in the Background of the Provisional Application of the '215 patent. (A00171-72.) The Provisional Application is incorporated by reference in the '215 patent. (A00133, 1:6-9.) There is no dispute that the Background is prior art. Furthermore, there is relatively little dispute about its meaning.

The Background of the Provisional Application makes clear that annealing was a *typical* technique to reduce contact resistance for Aluminum-based GaN contacts by stating:

> **Typical** low work function metals/metal stack which yield **low contact resistance to n-GaN on annealing is Al**, Ti/Al.

(A00171 (emphasis added).) The parties' experts agreed that this

sentence means what it says.[16] For example, as Emcore's expert testified:

> Q. And it [the first sentence of the Provisional Background] states that aluminum is typically used to achieve low contact resistance to n-type gallium nitride upon annealing; correct?
>
> A. Well, it is not described quantitatively there. But, yes, that's what it states.

(A20155, 155:15-19.) Likewise, the Background of the Provisional states that "most metallization schemes" on n-type GaN use Aluminum, Titanium, or a combination of the two, and that it was typical to use annealing to achieve *minimum contact resistance*:

> "most metallization schemes to n-GaN use Ti, Ti/Al or Al followed by Ni/Au. Annealing of the metallization is carried out at temperatures between 400-900 C for minimum contact resistance.

(A00172.) The Admitted Prior Art thus makes clear that Aluminum had been typically used as a base layer on n-type GaN, and that annealing was a common technique to minimize contact resistance.

[16] A00682-84 (Schubert); A20154-55 (Goorsky).

Emcore argues that the Admitted Prior Art teaches away from annealing any contact having an Aluminum base layer. For example, Emcore argues that:

> [T]he background of the provisional states that annealing contacts with an Al base layer is 'accompanied by degradation in the surface morphology, due to metallurgical reactions between the metal layers in the stack.' A00172. Nichia's expert described this as a 'warning' that annealing an Al-based contact could lead to 'degradation' of the device. A00701-02.

(Br. 12.) The Board correctly rejected Emcore's argument. (A00027-28.) The problem was not Aluminum, but Aluminum in contact with Gold. The Board thus concluded that the "warning" was not a warning away from annealing an Aluminum-based contact to n-GaN but, if anything, a warning toward using diffusion barriers (well-known in the prior art) between Aluminum and Gold. (A00043-44.)

The Board's conclusion is fully justified based on the text of the Admitted Prior Art. The Admitted Prior Art discusses the common use of Aluminum on n-GaN. (A00171.) The Admitted Prior Art also states that it is "essential" to use Gold as the terminating (top) layer. (A00172.) However, this leads to problems with wire bonding (which

occurs on the top layer of the stack) due to degradation of the surface morphology upon annealing. The degradation in surface morphology is stated to be "due to metallurgical reactions **between the metal layers in the stack**." (A00172 (emphasis added).) The layers in the stack discussed in the Background are Aluminum and Gold (or Nickel-Gold). (A00172.) So degradation is not due to annealing Aluminum by itself, but rather to the fact that Gold and Aluminum are allowed to interact.

This is the same problem Murarka solved in the 1970s. (A20207 ("To avoid gold-aluminum (1) interactions, a suitable diffusion barrier between Al and Au has to be provided.").) Murarka's solution, to use diffusion barrier layers between Aluminum and Gold, was used throughout the 1990s (*e.g.*, by Shibata, Fujimoto, and Kidoguchi). Professor Schubert's "warning" testimony was not that there was a warning away from the use of Aluminum, but rather that this well-known problem could affect wire bonding to the Gold layer. (A00701-03, 301:25-303:2.)

These considerations are relevant because Kidoguchi's contact *already provides a Ti/Pt diffusion barrier* between its Aluminum and Gold layers. Kidoguchi also recognizes and discloses the function of this

barrier. (A00226, ¶¶31-32.) Likewise, both Shibata (A00241, ¶28) and Fujimoto (A00193, 18:40-44) disclose using barrier layers between Aluminum and Gold. Given the presence of barrier layers in Kidoguchi's contact and the knowledge of their function in the prior art, a skilled artisan would not have viewed degradation of the Gold layer as an issue. The Board thus had ample evidence for its conclusion.

C. Emcore's Teaching Away Theories Are Not Credible In Light Of The Clear Statements Of The References

Emcore provides different teaching away arguments. At times, Emcore seems to argue that the prior art taught away from Aluminum base layers *per se*. (Br. 43 (arguing that the prior art "taught that a person of ordinary skill seeking to achieve the claimed invention would never have used [Aluminum].").) At other times, Emcore seems to argue that the prior art taught away from *annealing* an Aluminum-based contact. (Br. 38.) The Board's rejection of these arguments was supported by substantial evidence.

First, the prior art could not possibly have taught away from using Aluminum base layers on n-GaN layers *per se*, because the majority of references Emcore cites used Aluminum base layers. For example, the Board correctly found Kidoguchi teaches Aluminum base layers

(A00018), Shibata teaches Aluminum base layers (A00019), Fujimoto teaches Aluminum base layers (A00018), Luther teaches Aluminum base layers (A00031), and the Admitted Prior Art teaches Aluminum base layers (A00021).

Nor did the prior art teach away from *annealing* Aluminum-based contacts, as each of Shibata, Fujimoto, the Admitted Prior Art and Luther recommend annealing. Even the 1993 Foresi reference, upon which Emcore places much reliance, used Aluminum base layers under annealing. (A00245.) Foresi tested Aluminum and Gold contacts on n-GaN, noting that Aluminum was likely to produce an ohmic contact based on its work function. (A00245.)

Emcore makes much of an incorrect citation to Nakamura in the petition, ignoring the correct passage ten lines later in Nakamura and the correct citation thereto on page 25 of the petition. (A00093.) Nakamura teaches annealing the n-side contact "preferably" at 500°C or more. (A00213, 11:63-65.) Nakamura further states that "[w]hen the n-electrode material contains aluminum, a lower annealing temperature suffices, with 450°C or more being preferable…." (A00213, 11:65-68.)

Emcore is correct in observing that the *Background* of Nakamura states that "it has been found that aluminum and indium can hardly establish an ohmic contact," and tended to "degrade by an annealing treatment." (A00208.) The Board, however, quite correctly recognized (A00028) that the GaN semiconductor art underwent an intense period of development between the time Nakamura was filed (1993) to the time Emcore's provisional application was filed in October 2000. (*See* A00334, ¶18.) Every aspect of the technology improved. For example, Emcore's expert, Prof. Goorsky, testified:

> Q. Well, were each -- was each component of the gallium nitride-based LED improved throughout the 1990s?
>
> A. So what I would consider each component of the LED there were improvements in the components. Yes.
>
> Q. Was there also intense research throughout the 1990s specifically directed to the metal semiconductor interface of contacts to n-type gallium nitride semiconductors?
>
> A. Yes, absolutely.
>
> Q. And would that include the subject of whether the contact is ohmic or not?
>
> A. It would include whether the contact is ohmic or not, and, even more importantly, just improving the contact resistance of ohmic contacts.

(A20084, 85:8-23.)

Emcore tries to avoid the import of these developments by cutting its analysis off in 1997—three years prior to the relevant date under 35 U.S.C. § 103(a), and also the year the Luther article was published. For example, Emcore argues in its brief that:

> [E]**ven in 1997**, six years after the development of the GaN-based LED, **there was still a dearth of information** regarding the interaction of a contact's metal layers and a GaN semiconductor.

(Br. 6 (emphasis added).)

The Board found, however, that *in the relevant timeframe* (2000), the prior art taught *toward* annealing Aluminum-based contacts to n-type GaN. (A00028-29.) This culminated in the inventors' admission in their provisional application that Aluminum-based contact were *typically* used under annealing to make low-resistance contacts. (A00171.) The Board's conclusion that there was no teaching away from Aluminum base layers, annealing, or both together—*in the relevant timeframe*—was thus supported by substantial evidence.

D. The Board Correctly Articulated Its Reasons For Combining References

The Board's opinion properly articulates the reasons for annealing

the Kidoguchi contact. As stated in the original petition, annealing was an extremely common prior art technique—a fact that Emcore has never disputed. (A00076, A00108, A00103.) Furthermore, annealing was commonly used to improve contact resistance (A00108-09), and numerous references recommended annealing Aluminum-based contacts to n-GaN. (A00108-09.) Under *KSR*, 550 U.S. at 417, annealing was obvious as a known technique for improving semiconductor contacts that could have been applied to Kidoguchi's contact, without unpredictable results. (A00109-10.)

The Board recognized and cited to these arguments from Ground 4 (and Ground 3 on which it is based) of Nichia's petition. (A00016 ("Nichia provides explanations as to how each limitation is met by the combination of cited prior art references and rationales for combining the prior art references. Pet. 34-47.").) The Board then found that "[u]pon review of Nichia's contentions and supporting evidence, as well as Emcore's patent owner response and supporting evidence, we determine that Nichia has demonstrated, by a preponderance of the evidence, that claims 1-17 of the '215 patent are unpatentable over Kidoguchi, Nakamura, Fujimoto, Shibata, and the Admitted Prior Art."

(A00016.)

Furthermore, the Board summarized Emcore's arguments and Nichia's counter arguments at A00026-28, and then expressed agreement with Nichia. (A00028 ("We agree.").) This provided the underlying rationale for annealing Kidoguchi's contact, and is sufficient by itself to refute Emcore's critique that the Board presented no rationale for annealing Kidoguchi's contact.

Yet the Board continued its opinion, providing an additional, well-reasoned section refuting Emcore's individual contentions. This additional section was written in a manner dictated by the nature of Emcore's arguments. Specifically, Emcore was forced to acknowledge that the annealing of Aluminum-based contacts was ubiquitous in the prior art. Faced with this evidence, Emcore chose—despite the admissions in its Provisional Application—to re-interpret the prior art to arrive at a teaching away from annealing. (A00277.) The Board's opinion carefully dissects Emcore's arguments. In so doing, the Board showed how the prior art references taught *toward* annealing because annealing enhanced the quality of the contacts. As the Board found:

- "Fujimoto **teaches annealing** a multi-layered electrode—that

includes an Al base layer—at a certain temperature range, **to form a nitride compound semiconductor light emitting device having a low contact resistance and good wire bonding**." (A00029 (emphasis added).)

- "Contrary to Emcore's argument and its expert testimony …, **Shibata clearly discloses annealing an Al/Ti/Au electrode**—that includes an Al base layer—on an n-type GaN semiconductor at 600°C for one minute **to form a light emitting diode with low contact resistance and good ohmic contact**." (A00030 (emphasis added).)
- "Emcore and its expert ignore the fact that **others in the art had reproduced low contact resistance, similar to the results disclosed in Shibata**. Notably, Luther reported on a study of Al and Ti/Al contacts to n-type GaN that achieved a **low contact resistivity of 8 x 10^{-6} Ω cm^2 and good thermal stability**." (A00031-32 (emphasis added).)
- "In light of Shibata's disclosure, as a whole, **one with ordinary skill in the art at the time of the invention would have understood that** (1) using a barrier layer that has an optimal thickness would

> prevent the purported 'annealing' problem, and (2) **annealing an Al/Ti/Au electrode on an n-type GaN semiconductor under certain conditions would achieve low contact resistance and good ohmic contact.**" (A00032 (emphasis added).)

Emcore seems to demand that the Board use some magic formula to announce when it is making findings relevant to the reasons for combining references. No such requirement exists. This Court will even "uphold a decision of less than ideal clarity if the agency's path may reasonably be discerned." *In re Huston*, 308 F.3d 1267, 1281 (Fed. Cir. 2002) (quoting *Bowman Transp., Inc. v. Arkansas-Best Freight Sys., Inc.*, 419 U.S. 281, 285-86 (1974)).

The Board's opinion here is highly professional and well exceeds the standard articulated in *Huston*. In a sixty-four page opinion, the Board pointed out the specific benefits of annealing and exactly where they were taught in the prior art references. (A00026-33.) The Board refuted Emcore's counterarguments, showing how the unbiased evidence taught toward annealing of Kidoguchi's contact. The Board's path was sufficiently clear and led to the only correct conclusion.

E. The Board's Decision Concerning Claim 15 Was Correct

Emcore makes the same arguments concerning claim 15, which specifies a resistance limitation of "10^{-5} Ωcm^2 or less." Extensive evidence supports the Board's conclusion that this contact resistance range was obvious. Professor Schubert testified that a person of ordinary skill would obviously have annealed Kidoguchi's contact to achieve a contact resistance of 10^{-5} Ωcm^2 or less. (A00157, ¶55; A00163, ¶70.) The Board credited this testimony. (A00038-39.) Professor Schubert also noted—and Emcore has repeatedly agreed—that 10^{-5} Ωcm^2 was a middle-of-the-road contact resistance in the relevant timeframe (A00157, ¶55) and was thus in no way exceptional. Furthermore, as the Board found (A00032), both Shibata (A00241, ¶27) and Luther (A00762-64) taught annealing conditions for Aluminum-based contacts on n-GaN that resulted in resistances of 10^{-5} Ωcm^2 or less.

Further supporting the Board's finding is the lack of any apparent change in technique by the '215 patent. The '215 patent uses only prior art methods to deposit its metal layers. (A00134, 4:19-24.) There is no special preparation for the contact between the base layer and the

semiconductor. (*Id.*) The '215 patent does not present any particular layer thicknesses as important, but rather expressly states that the "thicknesses can be varied." (A00134, 4:36.) Likewise, as the Board noted (A00039), the '215 patent states that basically any annealing conditions are "sufficient for low contact resistances of the order of 10^{-5} ohm-cm^2 or lower." (A00134, 4:43-46.) While the '215 patent states that temperature range should be 400-600°C (A00134, 4:43-46), every prior art reference in Ground 4 uses annealing temperatures within that range.[17] There are no other special conditions to consider, as Emcore reaffirms in its brief by arguing that "however the invention is implemented, it will *always* result in a low-resistance contact" (Br. 24 (emphasis in original).)

The overall import of the prior art and Emcore's admissions is that the four-layer stack of Kidoguchi, annealed consistent with any of multiple prior art techniques within 400-600°C, will "always" result in low contact resistance. The Board thus had ample evidence to conclude that claim 15 was obvious.

[17] Shibata (A00241, ¶27 (600°C)), Fujimoto (A00192, 16:45-46 (400°C)), Admitted Prior Art (A00172, (400-900°C)), Nakamura (A00213, 11:65-67 (450 or 500°C)).

F. Other Dependent Claims Are Likewise Obvious

Emcore argues in passing (Br. 47) that the Board should not have found claims 6-10 and 16-17 obvious. These claims are directed to thickness ranges for various layers in the four-layer stack. Emcore argues that the Court should reverse the Board's findings, because Nichia's petition relies on a combination of Shibata and Fujimoto, which is supposedly not possible in light of Fujimoto's statements regarding Shibata. Emcore never made this argument to the Board, however. It is thus waived.

Even if Emcore had made the argument to the Board, the Board would have found claims 6-10 and 16-17 obvious. First, it is an oversimplification to say that the petition relied on a combination of Shibata and Fujimoto for these claims. Instead, the petition argued that the layer thicknesses in the claims were optimizable and thus obvious unless the claimed range was critical. (A00111.) The '215 patent disclaimed the criticality of the layer thicknesses by stating that "these thicknesses can be varied" (A00134, 4:36), and Emcore does so again on appeal by conceding that "however the invention is implemented, it will *always* result in a low-resistance contact" (Br. 24

(emphasis in original)).

Moreover, Professor Schubert testified that the thicknesses were not critical and could be optimized. (A00153-56, ¶¶44-51; A00162-63.) For example, the diffusion barrier layers can be optimized because they are generally better at preventing diffusion when they are thicker. (A00155, ¶50; A00153-54, ¶¶44-48.) The thickness of the Gold layer can be optimized because it needs to be sufficient to support the mechanical action of wire bonding. (A00154-55, ¶49.) The Aluminum layer needs to have a certain minimum thickness, but beyond that can be changed with relative freedom. (A00155-56, ¶51.)

Shibata and Fujimoto were cited in addition (along with other references) to show that the layer thicknesses were actually known in the prior art. (A00112-15.) In this sense, Shibata and Fujimoto were not "combined." Rather, their parameters were used to show that the layer thicknesses as applied to Kidoguchi would have been seen as typical. (*Id.*) For example, claim 6 recites that the "first barrier layer is at least about 300 Å [i.e. 30 nm] thick." The petition—without citing Fujimoto—showed that Shibata's barrier layer met this limitation, and that the thickness of the first barrier layer could be optimized.

(A00112.)

Regarding the selection of layer thicknesses, the Board found:

> We also have reviewed the parties' supporting evidence, and we credit the testimony of Nichia's expert over the testimony of Emcore's expert. [cite omitted]. We find the explanations proffered by Nichia's expert to be more consistent with the prior art teachings discussed above.

(A00036.) The Board was well within its discretion to credit one expert over another, especially where only one expert's testimony is in accord with the prior art. *See Yorkey v. Diab*, 601 F.3d 1279, 1284 (Fed. Cir. 2010).

G. Emcore Does Not Challenge The Board's Findings Concerning Secondary Considerations

Emcore, in the "Background" section of its brief, characterizes the '215 patent as a "Major Technological Breakthrough" and mentions a number of alleged advantages of the '215 patent. (Br. 14.) The alleged advantages include low contact resistance, thermal stability and wire bonding, leading to alleged use of the claimed method. (*Id.*) Emcore also states that the '215 patent has "stood the test of time" and is "used and praised" by Nichia. (*Id.*)

The Board found the alleged advantages to be no more than the

expected results based on the prior art. (A00043-44.) Similarly, the Board found that Emcore's arguments about "standing the test of time" and being "used and praised by Nichia" to be unpersuasive. (A00046-48.) "Standing the test of time" and being later "used" are not recognized forms of secondary evidence. They sound like the beginnings of a commercial success argument, but the Board found that Emcore did not timely present any commercial success argument. (A00061-62.) The Board also found that the commercial success argument that Emcore wanted to make was lacking any evidence concerning nexus, or any evidence that would show the nature of the effect on a relevant commercial market. (A00048.) The Board further found that Emcore's argument that the Al / Ti / Pt / Au **contact** "stood the test of time" and was "used and praised by Nichia" to be unpersuasive. (A00046-48.) This was in part because the claims are not directed to a contact *per se*. Instead, the claims of the '215 patent are directed to *method of making* a contact. And the Al / Ti / Pt / Au contact *itself* unquestionably belongs to the prior art. It is the contact of Murarka, the contact of Kawamura, and—as the Board found—the contact of Kidoguchi. (A00047.)

Emcore does not challenge the Board's secondary considerations

findings on appeal. Rather, Emcore simply reasserts its case below in the "Background" section of its brief, hoping perhaps to color the reader's judgment on later issues. This, however, is not sufficient to trigger appellate review, much less reversal. Any challenge to the Board's detailed findings regarding secondary considerations (A00041-49) is now waived.

CONCLUSION

The Board's decision is fully supported by the evidence, and should be affirmed.

Date: November 10, 2014

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CERTIFICATE OF SERVICE

I hereby certify that on this 10th day of November 2014, the foregoing Brief of Appellee Nichia Corporation was filed with the Clerk of the United States Court of Appeals for the Federal Circuit and served on counsel of record for all parties via the CM/ECF system.

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